



U.S. Geological Survey Programs in Kentucky

U.S. Department of the Interior ■ U.S. Geological Survey



The U.S. Geological Survey (USGS), which has offices in every State and Commonwealth, collects, compiles, and disseminates data on natural hazards and water, energy, biological, and mineral resources in the State of Kentucky. The long-term earth science information base of the USGS is a valued resource for the public and private sectors, academia, State and local agencies, and other Federal agencies. This Fact Sheet describes some of the USGS activities in Kentucky.

National Water-Quality Assessment Program

The USGS's National Water-Quality Assessment (NAWQA) Program was established to describe the status and trends in the quality of a large, representative part of the Nation's surface- and ground-water resources and to identify the natural and human factors that affect their quality. The NAWQA Program provides vital physical, chemical, and biological water-quality data to State and local officials charged with water-use planning and water-quality management.

From 1987 through 1990, the USGS collected water-quality data in the Kentucky River Basin as a part of the pilot NAWQA Program. The 7,000-square-mile Kentucky River Basin is the most densely populated major river basin in the State. The Kentucky River and its tributaries are used extensively for municipal and industrial water supply, recreation, and wastewater discharge and assimilation. The River provides more than 95 percent of the drinking-water supply to the 600,000 people in the Basin. Some components of water quality examined were the distribution of metals and other trace elements in the sediment and water; nutrients, sediments, and pesticides also were studied in the streams of the Basin.

Urban Hydrology and Surface-Water Quality of Jefferson County

Urbanization in Jefferson County is continuing at a steady rate. As land within a watershed is developed, there is, in general, a decrease in the amount of area for infiltration of rainfall. This results in high peak streamflows that occur more often than they might have previously (fig. 1). There also is generally an increase in the types and amounts of pollutants being transported to the streams.

The Louisville and Jefferson County Metropolitan Sewer District (MSD) is the lead agency responsible for managing surface-water resources in Jefferson County. These responsibilities include stormwater management and flood control; wastewater collection, treatment, and disposal; industrial waste pretreatment; and other related activities. The MSD's mission is to preserve, protect, and improve water quality in Jefferson County streams.

Index of Subjects

- National Water-Quality Assessment Program
- Urban Hydrology and Surface-Water Quality of Jefferson County
- Streamflow Data for Design and Permitting
- Oil and Gas Resources
- Assessment of Undiscovered Mineral Deposits
- Problem Solving in the Ohio River Alluvial Aquifers
- Topographic and Geologic Mapping
- Earth Science Information
- Effects of Mining-Related Disturbance on Ground Water
- Comprehensive Study of Geohydrology of Western Kentucky Industrial Complex
- Coal-Resource Data Collection
- Aquatic Ecology

The objectives of the joint program between the USGS and the MSD are to characterize the hydrology and water-quality conditions of streams in Jefferson County and to develop tools to use as aids in formulating strategies for the wise management of the water resources of these streams. A watershed-management approach is being adopted as the method



Figure 1. Water level 2 feet below peak during high-flow inspection at Boone Creek, Kentucky

to evaluate the effects of land use on stream hydrology and water quality within selected basins.

The most appropriate tool for use in the watershed approach is a continuous-based hydrologic/water-quality model. Such a model has been developed for the Beargrass Creek watershed, and one is being developed for the Chenoweth Run watershed. Eventually, other watersheds also would be modeled. These models allow the MSD to evaluate the effects that land-use changes, such as residential or industrial development, within each watershed, will have on the receiving streams.

The joint USGS/MSD program has focused primarily on the collection of baseline information to make gross assessments of water-quality conditions and the spatial variability of rainfall. Some baseline precipitation and water-quality data on streams throughout the County will continue to be collected. A project is underway to evaluate the current water-quality monitoring network and to decide whether a sampling location can be eliminated, visited less frequently, or remain in its current status. Part of this assessment is to evaluate the need for more storm sampling at the water-quality monitoring locations to characterize a variety of storm types and to define seasonal changes in water quality during storm-runoff periods.

Streamflow Data for Design and Permitting

Many State and local agencies in Kentucky need streamflow data and related information. For example, bridge and highway engineers need streamflow information to design bridges and culverts; water-treatment planners and managers need streamflow information to determine a stream's capacity to carry effluent; and water-supply planners and managers need this type of information to monitor current conditions and to estimate available supply for formulating plans for population increase and economic development.

Information collected at selected streamflow-gaging stations is used to monitor current conditions, such as droughts, and the information collected at these stations may be site specific (fig. 2). Some stations have been established primarily for regional analysis of streamflow data. The data and information collected at



Figure 2. USGS hydrologic technician collects water-quality data at Fort Campbell, Kentucky.

these stations also are site specific but are considered to be transferable and can, therefore, be used to develop regional equations to estimate selected streamflow characteristics at stream sites where little or no information is available. Typically, equations are developed to estimate stream-flow characteristics such as the 100-year peak discharge, which is used in the design of bridges and culverts and to delineate floodplain boundaries. Regional equations may also be developed to estimate selected low-flow characteristics such as the 7-day, 10-year low-flow discharge, which is used for water-quantity and water-quality permitting.

The Kentucky District recently analyzed the effectiveness of the streamflow-gaging station network in Kentucky and nearby stations in adjoining States. The results included a ranking of each station's importance to how much the information at each station reduced the error associated with estimates of streamflow at ungaged sites.

The network analysis technique also considered the inclusion of hypothetical (new) stations into the network. This allows the user to evaluate various locations where new gages could be installed and what types of basin characteristics would result in the greatest reduction of error associated with redefining the estimates of flow at ungaged sites.

Oil and Gas Resources

Much of Kentucky lies in the Appalachian Basin, which is a mature oil- and gas-bearing basin. The USGS, in cooperation with the Kentucky Geological Survey (KGS), is examining subsurface geologic structure and stratigraphy to determine the

potential for oil and gas production. As part of this effort, the USGS and the KGS have jointly acquired seismic-reflection data for the geologic feature known as the Rome Trough. The USGS has prepared detailed stratigraphic sections through ancient strata of the Trough. These data are used for locating subsurface structures and features, such as reservoirs and stratigraphic traps that may contain petroleum resources. The seismic-reflection data also are helpful in locating buried faults that may produce earthquakes in the future.

Assessment of Undiscovered Mineral Deposits

The USGS is completing a prototype quantitative national assessment of mineral resources for five commonly used metals—gold, silver, copper, lead, and zinc. To carry out this assessment, a cooperative project with the KGS has been initiated to collect the necessary data. This assessment will enable the USGS to respond quickly to requests for information about these mineral resources throughout the country from Congress, Federal and State agencies, industry, and the public. The assessment provides general mineral information to land-use planners who are concerned with resource-management issues, lists significant known deposits, identifies areas with mineral potential, and provides estimates of the quantity of each metal likely to be present. In Kentucky, tracts are delineated that have potential for containing different kinds of zinc and lead deposits. The assessment will be useful as a basis for more detailed, regional studies.

Problem Solving in the Ohio River Alluvial Aquifers

Ground water in the Ohio River alluvial aquifer is an important natural resource for numerous communities located within the Ohio River Valley. Increased use of this resource has been cause for increased attention to and awareness of proper ground-water-resource management policies and procedures. Currently, the USGS is conducting a number of investigations that address ground-water resources in the Carrollton area, ground-water movement near the city of Owensboro, and ground-water quality in the Louisville area.

Each of the USGS investigations is conducted in cooperation with a local governmental body or utility. The USGS and the Carroll County Water-Supply Planning Board are working together to provide a better understanding of the hydrogeologic conditions and to develop a ground-water model that can be used by managers to effectively and efficiently manage the area's ground-water resources to support the unprecedented industrial growth.

The USGS, in cooperation with the Owensboro Municipal Utilities, has completed a preliminary investigation of the hydrogeology of the alluvial aquifer at Owensboro and has developed a ground-water model that can be used by planners to simulate present conditions and the effects of projected demands on the aquifer and to reconfigure wellhead-protection areas as needed.

The USGS, in cooperation with the city of Louisville and an advisory group, the Louisville Aquifer Study Group, is working to design, install, sample, and maintain a network of ground-water-quality monitoring wells. The data collected from this investigation will provide an accurate assessment of the area's ground-water quality.

The alluvial aquifers along the Ohio River are and will continue to be important water resources. The USGS is working with local cooperators to increase the knowledge and to develop the tools needed to plan for future influences on these resources. Present investigations have been designed to collect and manage the needed data and incorporate them into regionally consistent tools that help water managers and environmental coordinators meet their water-use and environmental planning goals.

Topographic and Geologic Mapping

Among the most popular and versatile products of the USGS are its topographic maps at the scale of 1:24,000 (1 inch on the map represents 2,000 feet on the ground). These maps depict basic natural and cultural features of the landscape, such as lakes and streams, highways and railroads, boundaries, and geographic names; contour lines are used to depict the elevation and shape of terrain. Kentucky is covered by 779 maps at this scale. These maps are

useful for civil engineering, land-use planning, natural-resource monitoring, and other technical applications and have long been favorites with the general public for outdoor uses, including hiking, camping, hunting, exploring, and fishing expeditions.

The USGS is working with the KGS to develop an efficient method for preparing digital data from the USGS geologic map series of Kentucky. As a prototype, selected 7.5-minute geologic maps are being scanned to produce digital raster data that can be stored on CD-ROM's and used in a geographic information system (GIS) as a base for overlaying other digital data. The KGS is evaluating the initial results to assess the feasibility of digitizing the geologic maps statewide. All the 7.5-minute geologic maps for Kentucky could be scanned and stored on about 17 CD-ROM's.

The USGS is working with the Kentucky Geographic Information Advisory Council to produce a series of maps and plots demonstrating the use of currently available GIS technology with existing digital data, such as digital elevation models (DEM's), digital raster graphics (DRG's), and digital orthophotoquads (DOQ's). A DEM is an array of regularly spaced elevation values registered to a map base. A DRG is a scanned image of a USGS topographic map, and a DOQ is a digital image that combines the image characteristics of an aerial photograph with the geometric qualities of a map. These computerized products can be used interactively to revise obsolete maps.

The USGS is aiding the Kentucky office of GIS in evaluating existing digital information for use with the proposed State digital base map. The base map is being designed to provide a foundation with known positional accuracy that may be used to tie specific geographic data to by State and local agencies. Digital highway information has been evaluated for use with DOQ's and DRG's.

Earth Science Information

The Earth Science Information Centers (ESIC's) provide information to the public about USGS programs, products, and technological developments. The ESIC in Lexington was established under a cooperative agreement between the USGS and the KGS. As part of the national ESIC

network, this Center provides information on such earth science topics as cartography, geography, digital data, remote sensing, geology, geophysics, geochemistry, hydrology, geohydrology, aerial photography, and land use. It is supported by the USGS with reference materials, technical assistance, training and outreach activities, and access to USGS data bases.

The STATEMAP Component of the National Cooperative Geologic Mapping Program is funded through a matching grant with the KGS. The purpose of the project is to convert Kentucky 7.5-minute geologic quadrangle maps to digital format. The 161 maps that comprise the Kentucky River Basin have been selected to be the first maps converted. The digital geologic maps, as well as other GIS data, are useful to assess surface and ground water, mineral resources, and environmental geology in the Basin.

Effects of Mining-Related Disturbance on Ground Water

The effects of acidic mine drainage in the Appalachian Region coal fields in eastern Kentucky and adjacent States are well known and extensively studied; however, the effects of mining-related disturbances on ground water are not well known. Most households in rural Appalachia in Kentucky obtain water from privately owned wells and springs. Much anecdotal evidence is available to indicate that blasting, mining-related subsidence, and acidic drainage can affect ground water, but these effects are generally not well documented, and cause-and-effect relations between mining-related disturbance and degradation of ground-water quality and quantity are poorly understood.

In a recent study done by the USGS, in cooperation with the Office of Surface Mining Reclamation and Enforcement, dye-tracer tests were used to investigate the movement of ground water in coal-bearing rocks near an abandoned underground coal mine near Fishtrap Lake in Pike County. Nontoxic fluorescent dyes were injected into a well at the top of a ridge several times between 1985 and 1992. The subsurface movement of the dyes was monitored by using water samples collected from monitoring wells drilled at different depths into the ridge top and adjacent valley walls.

For More Information

The results of the study confirmed that dye-laden ground water moved most rapidly through interconnected fractures in bedrock and coal beds. The direction and rate of movement of the dyes was highly variable and mostly dependent on fluctuations in ground-water elevations that had been caused by changes in hydrologic conditions. In one tracer test, dye moved from the ridge top to the deepest wells at an estimated velocity of 36 feet per day. However, rapid movement of dyes to downgradient wells did not seem to result in quick or efficient flushing of the dye from the ground-water system. Instead, residual dyes, which are present in less transmissive fracture zones, were periodically flushed following recharge events and intermittently detected in downgradient wells weeks and even months after injection.

The results of these dye-tracer tests are important because they provide direct evidence of the rapid movement of ground water through fractures in ridge- and valley-wall settings typical of the Appalachian Region coal fields and the effects of mining-related subsidence on ground-water flow paths. The movement of dyes during the tracer tests provides a conceptual model for the migration of mining-related contaminants in fractured and layered coal-bearing rocks that can be tested and refined by future ground-water-quality studies.

Comprehensive Study of Geohydrology of Western Kentucky Industrial Complex

The USGS, in cooperation with the Department for Environmental Protection (DEP) of the Kentucky Natural Resources and Environmental Protection Cabinet, is working to understand and characterize the environmental conditions and water resources of an area that includes an industrial complex near Calvert City, so that the risk to public health and the environment can be assessed. The resultant data and study findings will assist the DEP in deciding how to remediate or abate problems related to past waste-disposal practices in the area and in facilitating cooperation of the public, waste industry, and government to manage and plan for future protection and reduction of risk to the environment.

To address problems of potential ground-water contamination from the industrial complex, it was necessary to understand the geology and hydrology of

the aquifer in the area to predict how long it would take contaminants to move from one place to another in the ground water and what direction they would take. To understand the geohydrology, test wells were drilled, ground-water levels were monitored, and streamflows in nearby streams were measured.

A ground-water flow model was constructed to simulate the flow of water in the aquifer in response to withdrawals from hypothetical wells at selected sites in the study area. The results of the model simulations were used to show what happened to the water levels in the area, the flow direction of the ground water for each withdrawal plan and the contributing area or source of water to the hypothetical wells.

Coal-Resource Data Collection

Several other major efforts are currently active in Kentucky. The USGS's National Coal Resources Data System, in cooperation with the KGS, is collecting coal-resource data. Coal resources in the eastern and western Kentucky coal fields are being assessed under the USGS/KGS coal availability/recoverability investigations. A 2-year USGS/KGS study of potentially toxic trace elements in the fuel cycle of a coal-burning powerplant has concluded its first phase of monthly sample collection and is entering its assessment phase.

The USGS National Coal Assessment has undertaken a project to collect digital outcrop data for two major coal beds in Kentucky.

Aquatic Ecology

The Biological Resources Division (formerly the National Biological Service) of the USGS conducts research and provides scientific data needed by land managers to manage effectively aquatic-related resources in Kentucky. The USGS is assessing the life history characteristics and habitat requirements of several species of endangered mussels of the Green River Basin to facilitate the successful recovery of these species. As part of the Appalachian Clean Streams Initiative, which is a program to help mitigate the effects of acidic mine drainage on the environment, the USGS is providing biological information and technical expertise in Kentucky's Rock Creek watershed.

USGS State representative
9818 Bluegrass Parkway
Louisville, KY 40299
(502) 493-1900
Fax: (502) 493-1909
Email: dc_ky@usgs.gov

Additional earth science information can be found by accessing the USGS Home Page on the World Wide Web at <http://www.usgs.gov/>

For more information on all USGS reports and products (including maps, images, and computerized data), call **1-800-USA-MAPS**

The **USGS** provides maps, reports, and information to help others meet their needs to manage, develop, and protect America's water, energy, mineral, biological, and land resources. We help find the natural resources needed to build tomorrow, and supply the scientific understanding needed to help minimize or mitigate the effects of natural hazards and environmental damage caused by natural and human activities. The results of our efforts touch the daily life of almost every American.

U.S. Geological Survey
Fact Sheet FS-016-96